English Loanword Phonology in Korean*

Hyoeun Lee

1. Introduction

The purpose of this paper is to provide a formal account for the realization of English loanwords in Korean. Loanwords are defined as "words which have been copied into a language from another language, as a result of contact" (Trask 1996). The phonetic forms of English loanwords in Korean are not always identical to the corresponding original English words. Specifically, it is often the case that the laryngeal feature values of English obstruents are not maintained in Korean. For example, word-initial voiced stops in English are realized as voiceless lenis stops in Korean: [kɛp'] 'gap'. English voiceless unaspirated stops as in 'stress' become aspirated in Korean: [sɨtʰɨrɛsɨ]. Most previous research on Korean loanword phonology (H. Kang 1996, O. Kang 1996) does not even attempt to account for these featural changes, considering them somewhat automatic. However, given the complexity of the Korean obstruent system with a three-way laryngeal contrast, it seems obvious that these featural transfers are not exactly easy to understand. Thus, the present study explores the way in which laryngeal features of English obstruents are realized in Korean. We will provide an in-depth discussion of the acoustic properties of English and Korean obstruents, and, then, based on the discussion, we will provide perception-based analyses of English loanwords in Korean. These analyses will be formalized within the framework of Optimality Theory (Prince & Smolensky 1993; McCarthy & Prince 1993, 1995).

This paper is organized as follows. In section 2, we will discuss how

* I am most grateful to Jongho Jun for his generous and helpful guidance. I would like to thank Gyungran Kim and two anonymous reviewers for their helpful comments.

English obstruents are realized in Korean. In section 3, we will first examine Silverman's (1992) framework for English loanword phonology in Cantonese, the framework on which most previous analyses of loanword phonology in Korean are based. We will then discuss analyses of H. Kang (1996) and O. Kang (1996), pointing out their defects from the perspective of OT. In Section 4, we will provide an alternative analysis of English loanword phonology in Korean, employing perception-based constraints. In section 5, we will summarize our claims.

2. Data

Let us begin with a comparison of laryngeal features of English with those of Korean. English obstruents contrast in voicing, but not in aspiration and tense. In contrast, Korean obstruents involve a three-way contrast—lax, tense, and aspiration. However, they have no contrast in voicing, and alveolar fricatives lack an aspirated counterpart.

Let us now investigate the way in which English obstruents are realized in Korean. The data will be divided into two groups, voiceless and voiced non-continuants, as shown in (1):

(1) The phonetic realization of laryngeal features of English non-continuants obstruents

English		Korean	Examples		
			English		Korean
a. voiceless	(i) aspirated onset	aspirated	**kʰ**i	'key'	**kʰ**i
			čʰæmpɪən	'champion'	**č**ʰɛmpʰɪon
	(ii) unaspirated onset		st**r**ɛs	'stress'	si**t**ʰi**r**ɛsi
	(iii) coda	aspirated onset	ro**p**	'rope'	ro**p**ʰi
			bU**k**	'book'	kʰə**t**ʰi
		unreleased	kʰʌ**t**	'cut'	pU**k**˺
					kʰə**t**˺
b. voiced	(i) onset	voiceless unaspirated	**g**æp	'gap'	**k**ɛp˺
			ǰab	'job'	**č**ap˺
	(ii) coda	voiceless unreleased	kʰlʌ**b**	'club'	kʰillə**p**˺
		onset	b**ɛ**d	'bed'	p**ɛ**di
			laUn**ǰ**	'lounge'	raUn**ǰ**i

As shown in (1a i), word-initial voiceless aspirated stops and affricates in English are realized as such when adopted into Korean. As shown in (1a ii), voiceless unaspirated stops after /s/ in English are also realized as aspirated at the onset of the second syllable, the nucleus of which is an inserted vowel. As shown in (1aiii), English word-final unreleased stops, which are in free variation with released ones (Ladefoged 1993), become aspirated or unreleased ones in Korean. For instance, a vowel is inserted in ro[**p**]e but not in boo[**k**], so that the stop in the former can be an onset. The choice between the aspirated onset in [ro**p^{h}**i] and the unreleased coda in [pU**k˺**] seems arbitrary since there is no difference in phonological environments—compare between grou[**p˺**] and loo[**p^{h}**i], and between boo[**k˺**] and moo[**k^{h}**i]. In fact, both unreleased and aspirated forms are available for words such as cu[**t**]. As shown in (1a), the voicelessness of English voiceless obstruents is maintained when adopted into Korean, but this is not always the case with the voicing of English voiced obstruents. As shown in (1b i), English voiced obstruents in the word-initial position are consistently realized as voiceless unaspirated ones in Korean. As shown in (1b ii), those in the word-final position become either voiceless or voiced ones in Korean. In the latter case, the syllable position has changed from the coda to the onset through the insertion of an epenthetic vowel. As shown in (1a i &b i), the contrast of voicing of initial stops in English (**k**ey vs. **g**ap) is transferred to that of aspiration in Korean ([**k^{h}**]ey and [**k**]ap).

In section 3, we will discuss how these data have been analyzed in some previous researches.

3. Previous Researches

3.1. Silverman (1992)

Let us summarize Silverman's (1992) framework for Cantonese loanword phonology, the theoretical framework on which most of the previous works on Korean loanword phonology (Lee 1995; H. Kang 1996; O. Kang 1996) heavily rely.

Silverman argues that loanword phonology consists of two distinct ordered levels: perceptual and operative. At the perceptual level, the inputs are assumed as superficial non-linguistic acoustic signals, lacking all phonological representations of the source language. These are constrained

by the segment inventory of native phonology. That is, if the segments of loanwords exist in the native segment inventory, they are matched with those of the native language at the perceptual level. Otherwise, they will be matched with the native segments that approximate most closely those of the source language with respect to articulatory or acoustic properties. At the next operative level, the native phonotactic constraints are applied to the output of the perceptual level.

Among the previous works, we will focus on H. Kang's (1996) and O. Kang's (1996) Optimality-Theoretic analyses.

3.2. H. Kang (1996)

Following Silverman (1992), H. Kang claims that English loanword phonology in Korean is composed of the perceptual and operative levels. In the former, the sounds of borrowed words from English are constrained by the Korean native segment inventory. In the latter, the Korean native phonotactics are applied to the output of the perceptual level. Let us consider her analyses of some specific instances.

First, she argues that the contrast of voicing in English (**k**ey vs. **g**ap) takes the form of aspiration in Korean at the perceptual level ([**kʰ**]ey vs. [**k**]ap) since in Korean, voicing is not contrastive but aspiration is.

Second, for an English loanword for [si**th**iresi] 'stress' shown in (1a ii)[1], she claims that unaspirated stops following /s/ in English are affected by the spelling of the source language. That is, an unaspirated /t/ after /s/ in 'stress' is perceived as an aspirated /tʰ/ in Korean at the perceptual level because the spelling 't' in English is pronounced with an aspiration, i.e. [tʰi]. At the next operative level, the phonotactic constraints of Korean native phonology are applied to the output forms of the perceptual level, i.e. /s**th**res/: the Korean syllable structures allow [p, t, k, m, n, ŋ, l] as codas and released consonants as onsets. Thus, /s/ in the coda in English is not syllabified as a coda in Korean. Word-initial /s/, which is regarded as a released consonant by Kang, and other released consonants, e.g. an aspirated /tʰ/, are syllabified as the onset by inserting an epenthetic vowel. /r/ before a vowel is also syllabified as the onset.

---

[1] For the phonetic transcriptions in the examples, we use the same phonetic symbols that H. Kang (1996) adopts.

3.3. O. Kang (1996)

O. Kang's approach is similar to H. Kang's in positing the perceptual level. Influenced by Silverman (1992), O. Kang postulates that the sound matrices of source language are perceived at the perceptual level by the speakers of borrowing language. She assumes that these become the input forms of an Optimality-Theoretic grammar, in which the native phonotactic constraints are effective. Let us consider her analyses of several specific cases.

Firstly, in her analysis of loanwords shown in (1a i &b i), i.e. [**kʰ**]ey vs. [**k**]ap, O. Kang argues that since voicing is not contrastive in Korean, the contrast of aspiration in Korean is substituted for that of voicing in English as in H. Kang (1996).

Secondly, she mentions the asymmetry in the insertion of a vowel in English word-final stops mentioned in (1a iii), i.e. ro[**pʰi**] vs. boo[**k˺**]: she claims that since both English released and unreleased stops are perceived by Korean native speakers, they should be represented at the perceptual level. In other words, it is argued that when the segments with [±release] feature in English are borrowed into Korean, [±release] feature is represented at the perceptual level in Korean. At the operative level, English released stops, [pʰ, tʰ, kʰ], are realized as onsets through the insertion of a vowel in Korean, while English unreleased ones, [p˺, t˺, k˺], are realized as codas in Korean. In brief, a vowel is inserted after released stops in order to preserve [+release] feature of English, but is not inserted after unreleased ones.

Thirdly, with respect to the realization of word-final voiced stops in English shown in (1b ii), i.e. clu[**p˺**] vs. be[**di**], she claims that English word-final voiced stops, /b, d, g/, are perceived as voiceless released ones, /p˜, t˜, k˜/[2], at the perceptual level in Korean. Then, at the next operative level, a vowel is inserted, so that they surface as voiced ones, [b, d, g].

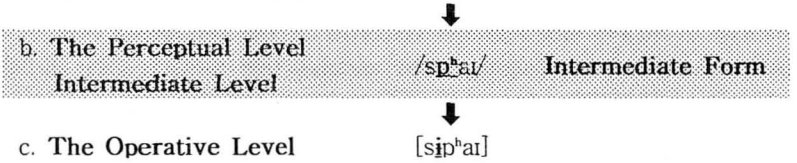
Let us discuss the defects of H. Kang's (1996) and O. Kang's (1996) analyses. First, both approaches postulate two derivational levels, perceptual and operative, in the grammar, which is inappropriate from the viewpoint of the parallelism OT (McCarthy & Prince 1995). That is, in OT, a grammar disallows intermediate stages between the input and output. The following diagram is the outline for both frameworks (Note the underlined segments):

---

[2] For release, O. Kang (1996) employs phonetic symbols, [ʰ] and [˜].

(2) H. Kang's (1996) and O. Kang's (1996) frameworks for loanword phonology

a. Output form in English [spaɪ]



As shown in (2), there is a stage in which the surface form in English is mapped onto the sound matrices at the perceptual level. More specifically, an unaspirated [p] (2a) in English is perceived as an aspirated [pʰ] (2b) at the perceptual level in Korean. Thus, the perceptual level is an intermediate level. At the next operative level (2c), the interaction of constraints produces the surface form with an epenthetic vowel as in [sɨpʰaɪ]. Thus, like Silverman's framework their accounts assume a two-step derivation.

Secondly, in both Kangs' approaches, it is assumed that the perceptual level is constrained by the native segment inventory. This perception process is separated from the interaction of constraints in the operative level. However, in OT, a phoneme inventory is captured by the interaction of phonotactic constraints and faithfulness constraints (Prince & Smolensky 1993; see section 4 for the relevant discussion). Thus, the perception process constrained by the native phoneme inventory, should be part of the constraint interaction that forms the operative level.

Thirdly, both of them suggest that the reason why the contrast of voicing in English is realized as that of aspiration in Korean, is that in Korean, voicing is not contrastive, whereas aspiration is. But, tensification is also contrastive in Korean, just as aspiration is. Thus, it is possible that according to their logic, voicing contrast in English is realized as tense one in Korean.

Fourthly, as discussed in 3.2, H. Kang suggests that when the words beginning with /s/-stop sequences in English enter Korean, spelling pronunciation has an effect on the realization of stops. Why are only stops after /s/ affected? Words like 'center, college, special' have a spelling 'c' in common; however, their phonetic realizations in Korean are different, but very much like their corresponding English pronunciations. According to her logic, all underlined segments should be pronounced with [s] in Korean since the spelling 'c' in English is pronounced with [si]. Nevertheless, this

is often not the case.

Based on the above discussion, we can conclude that neither of Kangs' approaches does not provide fully detailed explanations and analyses for English loanword phonology in Korean.

4. Analysis

In this section, within the framework of OT, we will provide a perception-based analysis of English loanwords in Korean. We agree with Silverman (1992), in assuming that the native speakers of borrowing language, i.e. Korean, have no access to the phonological representation of source language, i.e. English. Therefore, the actual output forms of English are "merely superficial non-linguistic acoustic signals" (Silverman 1992), and they are the input forms of Korean grammar.

Firstly, let us discuss how the Korean phoneme inventory is captured in OT. What markedness constraints are active? Aspirated stops involve "a glottal abduction gesture of considerable magnitude" (Ladefoged & Maddieson 1996, Hayes 1999). The fortis stops involve "tenser vocal tract walls and a more rapid increase in respiratory muscle force" (Ladefoged & Maddieson 1996); the production of aspirated and fortis stops requires much extra articulatory effort. Thus, it is possible to conclude that they are universally more marked than voiceless lenis ones. The universal constraints reflecting these phonetic factors, can be formulated as follows:

(3) a. *[+spread glottis] = *ASP: Avoid aspiration (Hayes 1999).
b. *[+stiff voice] = *FORTIS: Avoid fortis stops.

It is difficult to maintain voicing during the stop closure since the accumulation of air flow in the oral cavity causes oral pressure to approach subglottal pressure. When this happens, the air flowing through the glottis decreases and voicing ceases (Ohala 1983). According to this point of view, voiced stops are marked and disfavored. Therefore, we can formulate a context-free markedness constraint as below:

(4) *VCDOBS: No obstruents must be voiced (Hayes 1999, Kager 1999).

(4) implies that the normal state of stops is voiceless.

The faithfulness constraints conflicting with the markedness constraints just discussed, are in (5). They are formulated by IDENT as suggested in McCarthy and Prince (1995).

(5) a. IDENT[asp]: The value of the feature [spread glottis] in the input must be preserved in its output correspondent.
b. IDENT[fortis]: The value of the feature [stiff voice] in the input must be preserved in its output correspondent.
c. IDENT[voice]: The value of the feature [voice] in the input must be preserved in its output correspondent.

All constraints in (5) play a role in prohibiting differences of the value of given features between the input and output.

In Korean, voiced obstruents are not phonemes, but they appear as allophones of voiceless ones. They occur between voiced segments, and voiceless ones elsewhere. Specifically, voiceless lenis obstruents become voiced between sonorant segments, e.g. /kʰoŋ-**p**ap/ → [kʰoŋ**b**apˀ] 'bean-mixed rice'. However, aspirated and tense ones are not voiced even in voiced surroundings, e.g. /tʰɛ-**p**ʰuŋ/ → [tʰɛ**p**ʰuŋ] 'hurricane', /kʰin-**t'**al/ → [kʰi nt'al] 'eldest daughter' (Kim-Renaud 1974: 8-10). These facts may be captured in the following constraint:

(6) *VCLESSLENIS / [+son] ____ [+son]
Voiceless lenis obstruents between voiced segments must be voiced.

(6) plays a role in prohibiting voiceless lenis stops in voiced surroundings.

The ranking of the constraints leading to the Korean consonant inventory, is as follows:

(7) The constraint ranking for the Korean consonant inventory

IDENT[asp], IDENT[fortis], *VCLESSLENIS / [+son] ___ [+son] ≫ *ASP, *FORTIS, *VCDOBS ≫ IDENT[voice]

This illustrates the fact that in the Korean consonant inventory, voiced consonants as well as voiceless aspirated, fortis and lenis ones, do exist.

Let us now consider the constraints and their rankings in the realizations of English loanwords. To understand the patterns in section 2, which can

be observed in the realization of English stops in Korean, we need to discuss the acoustic characteristics of stops. First, let us discuss the differences between voiceless and voiced stops. Recall that voiceless aspirated stops in English are realized as such in Korean, as shown in (1a i), and that word initial voiced ones in English are consistently realized as voiceless unaspirated ones, as shown in (1b i).

Stops are acoustically characterized by the presence of a transient noise burst at the moment of release, which is somewhat more intense and thus more noticeable in the voiceless rather than voiced stops (Borden, Harris & Raphael 1994). Another acoustic feature associated with stops, is voice onset time (VOT) defined as "the moment at which the voicing starts relatively to the release of a closure" (Ladefoged 1993). In wideband spectrograms, the duration of the vertical spike marking the transient burst of a stop release and the first vocal pulse amounts to the values of VOT. In other words, VOT can be defined as release duration. Byrd (1993 : 102) demonstrates the difference between English voiceless and voiced stops in release duration or VOT: the release duration of voiceless stops is relatively longer than that of voiced ones. Specifically, she reports that the mean release duration for voiceless stops is 49ms and for voiced stops, is 22ms; voiceless release duration is twice that of voiced release duration. Stevens (1989 : 42) states that "the abruptness of the onset for an obstruent unaspirated stop consonant is presumably stronger if the consonant is voiceless than if it is voiced, because of the greater intraoral pressure for voiceless stops," making apparent a significant difference in release duration and intensity between voiceless and voiced stops—the VOT or release duration of voiceless stops is longer and more noticeable than that of voiced ones. Thus, we can deduce that the former must be perceptually or acoustically more prominent than the latter. To formally represent this release prominence of stops, we employ VOT as features, e.g. [+/-positive VOT] (Flemming 1995). The following is the representation of voiceless and voiced stops.

(8) The representation of voiceless and voiced stops

	Voiceless release	Voiced release
positive VOT	+	-

[Positive VOT] in (8) differentiates voiceless from voiced release; the former is represented as [+positive VOT] and the latter as [-positive VOT].

Note that [-positive VOT] cannot necessarily be equated with negative VOT values; a feature [positive VOT] is employed simply to differentiate between the release prominence of voiceless stops and that of voiced stops.

We propose faithfulness constraints for release prominence by employing MAX, a kind of faithfulness constraint proposed by McCarthy & Prince (1995), in the following assertions:

(9) a. MAX[+positive VOT]
[+positive VOT] in the input must be preserved in the output.
b. MAX[-positive VOT]
[-positive VOT] in the input must be preserved in the output.

(9) requires that the value of [positive VOT] in the input is maintained in the output. Adhering to Jun (1995), we deduce that a constraint requiring preservation of perceptually more prominent elements, must be ranked above that requiring preservation of less prominent ones. Therefore, based on the above discussions of release prominence, we establish the following universal ranking for faithfulness constraints for the release:

(10) MAX[+positive VOT] ≫ MAX[-positive VOT]

(10) indicates that the release of voiceless stops is more likely to be preserved than that of voiced ones. Therefore, we can predict that voiceless release prominence in '**k**ey' is more likely to be preserved than the voiced one in '**g**ap'.

Recall that both voiceless aspirated and unaspirated stops in English are realized as aspirated in Korean—this is illustrated in (1a i & ii). Let us compare voiceless aspirated stops with unaspirated stops in terms of VOT.

Firstly, aspirated and unaspirated stops differ in VOT values: aspirated stops have a longer VOT than that of unaspirated stops (Ladefoged 1993, Ladefoged & Maddieson 1996).

Secondly, voiceless aspirated and unaspirated stops differ in the strength of the release: "The voiceless unaspirated stops are weakly released or not released at all, but the aspirated ones have a shorter closure and a noticeable burst followed by noisy airflow that is sustained for some considerable time" (Ladefoged & Maddieson 1996 : 67). To sum up, aspirated stops have longer and more intense voiceless release than unaspirated stops, and we may thus conclude that the former must be acoustically more

prominent than the latter.

Next, let us specifically compare English with Korean voiceless stops. English voiceless stops in a word-initial position are aspirated and have a long positive VOT. Korean /p^h, t^h, k^h/ are quite similar to those of English (Yang 1993), but their VOT values are much longer than those of English, as shown in (11):

(11) Summary of VOT (ms) in aspirated stops reported by Lisker & Abramson (1964) (from Cho & Ladefoged 1999 : 208)

	Cantonese	English	Eastern Armenian	Korean
p^h	77	58	78	91
t^h	75	70	59	94
k^h	87	80	98	126

As shown in (12a&b), voiceless stops after word-initial /s/ in English have VOT values close to those of unaspirated fortis stops in Korean (Yang 1993). But the mean VOT values of Korean are a little shorter than those that exist in English. As shown in (12c), the VOT value of Korean voiceless lenis stops is longer than that of English voiceless unaspirated stops in (12a), but shorter than English aspirated ones in (11).

(12) The VOT comparison between English and Korean voiceless stops (Yang 1993 : 53-54)

	a. English produced by seven American students			b. Korean produced by seven Korean students			c. Korean produced by seven Korean students		
	s[p]	s[t]	s[k]	p'	t'	k'	p	t	k
AV.	16	25	29	12	16	24	35	39	53
R.	12 : 22	19 : 32	18 : 37	7 : 17	8 : 29	7 : 40	14 : 65	15 : 81	31 : 66
N.	7	7	7	14	14	14	21	21	21

(AV: average values of VOT, R: range, N: number of tokens)

According to the above VOT values, English and Korean voiceless stops can be categorized as follows: English and Korean voiceless aspirated stops are characterized by a voiceless strong release, that is acoustically the most prominent, whereas English voiceless unaspirated stops, Korean voiceless fortis stops, and lenis stops are characterized by a somewhat prominent voiceless weak release, English voiced stops with a voiced release, are the least prominent.

[Positive VOT] in (8) does not distinguish voiceless strong from weak

release as shown in (11) and (12), since both of them have [+positive VOT]. To make such a distinction, we adopt a feature [long VOT]: [+long VOT] for strong release and [-long VOT] for weak release. We claim that in English loanword phonology in Korean, these VOT features play a crucial role in identifying similarities and differences in release prominence of English and Korean stops, as shown in (13).

(13) Release prominence

	English & Korean voiceless aspirated stops	English voiceless unaspirated & Korean lenis, fortis stops	English voiced stops
	Voiceless strong release	Voiceless weak release	Voiced release
positive VOT	+	+	-
long VOT	+	-	-

Diagram (13) indicates that voiceless strong release is common to both English and Korean voiceless aspirated stops, voiceless weak release to English voiceless unaspirated, Korean voiceless lenis, and fortis stops, and voiced release to English voiced stops. It also shows that the acoustic features associated with voiceless strong release are [+positive/+long VOT], those associated with voiceless weak release are [+positive/-long VOT], and those associated with voiced release are [-positive/-long VOT].

Since the actual output forms of English are the input to the loanword phonology, we need the faithfulness constraints evaluating those output forms. That is, the constraints minimizing differences between the actual output forms of English and the surface forms articulated by Korean, are required. Specifically, we propose the following faithfulness constraints for different types of VOT.

(14) a. MAX[+positive VOT] (=9a)
b. MAX[-positive VOT] (=9b)
c. MAX[+long VOT]: [+long VOT] in the input must be preserved in the output.
d. MAX[-long VOT]: [-long VOT] in the input must be preserved in the output.

(14a) prevents voiceless stops in the input from corresponding to voiced

ones in the output. (14b) prevents voiced stops in the input from corresponding to voiceless fortis or lenis ones in the output. (14c) prevents voiceless aspirated stops from becoming either voiceless unaspirated or voiced stops. (14d) prevents voiceless unaspirated stops in the input from becoming aspirated ones in the output. We propose the following universal rankings among constraints in (15):

(15) a. MAX[+positive VOT] ≫ MAX[-positive VOT] (=10)
b. MAX[+long VOT] ≫ MAX[-long VOT]

(15) indicates that if less prominent elements with [-positive VOT] and [-long VOT] are preserved, then the more prominent ones with [+positive VOT] and [+long VOT] must be preserved. For example, if unaspirated stops are preserved, then aspirated ones must be preserved.

We claim that "Local Conjunction" proposed by Smolensky (1993) is active in English loanword phonology in Korean. That is, multiple violations of given constraints in a local domain are worse than the same violations in a non-local domain. We employ a following locally conjoined constraint:

(16) $[\text{MAX[-positive VOT]} \ \& \ \text{MAX[-long VOT]}]_{\text{segment}}$

(16) prevents voiced stops in the input from becoming voiceless aspirated stops in the output. It is violated if and only if both MAX[-positive VOT] and MAX[-long VOT] are violated in the same segment. It is universally assumed that the conjunctive constraint is ranked above individual component constraints (Itô & Mester 1998). Therefore, we can assume that the constraint in (16) is ranked above those in (14b&d).

(17) a. $[\text{MAX[-positive VOT]\&MAX[-long VOT]}]_{\text{segment}} \gg \text{MAX[-positive VOT]}$
b. $[\text{MAX[-positive VOT]\&MAX[-long VOT]}]_{\text{segment}} \gg \text{MAX[-long VOT]}$

Note that the concept underlying this ranking is that a drastic change must be avoided in order to adopt a less drastic one.

Other faithfulness constraints active in loanword phonology are as follows:

(18) a. MAX[rel]: The release in the input must be preserved in the output.
b. DEP[rel]: The release must not be inserted.

(18a) indicates that a released segment in the input must be released in the output. (18b) blocks the insertion of a release. Observe that this constraint will be violated if a vowel is inserted after a stop since a stop before a vowel is obligatorily released.

We now propose the following ranking of faithfulness constraints for the analyses of English loanwords in Korean[3].

(19) The ranking of faithfulness constraints for release prominence

$$\begin{array}{c} \text{MAX[+positive VOT], MAX[+long VOT]} \\ \text{[MAX[-positive VOT] \& MAX[-long VOT]]}_{\text{segment}} \\ \text{MAX[rel], DEP[rel]} \end{array} \gg \begin{array}{c} \text{MAX} \\ \text{[-positive} \\ \text{VOT]} \end{array} \gg \begin{array}{c} \text{MAX} \\ \text{[-long} \\ \text{VOT]} \end{array}$$

Let us consider some universal markedness constraints that conflict with faithfulness constraints discussed above. The constraints discussed in (3), (4), and (6) are still active in producing English loanwords.

Initial voiced obstruents are disfavored because it is difficult to start vocal cord vibration during an obstruent; so it is preferable to devoice stops in this position (Flemming 1995). Hayes (1996 : 16) shows that in a word-initial position, voiced stops require more effort than voiceless stops. Therefore, we can formulate a context-sensitive markedness constraint as follows:

(20) *VCDINITOBS = $*\text{VCDOBS}^{\text{INIT}}$
No obstruents in a word-initial position must be voiced.

It is difficult to maintain voicing in a word-final position as well, since "the subglottal pressure that drives voicing tends to be lower in this position" (Hayes 1996 : 8). Thus, another context-sensitive markedness constraint can be formulated as follows:

(21) *VCDFINALOBS = $*\text{VCDOBS}^{\text{FINAL}}$
No obstruents in a word-final position must be voiced.

---

[3] Since no segments of English loanwords in Korean are deleted but an epenthetic vowel is frequently inserted, we can state that in English loanword phonology in Korean, MAX[segment] is as high as MAX[rel] or DEP[rel] but DEP[segment] is not. In this paper, the evaluations for MAX[segment] and DEP[segment] are not considered.

Consequently, we can state that voicing is favored in a word medial position and disfavored in an initial and final position. Thus, the two constraints in (20) and (21) can form a following single constraint:

(22) *VCDMRGOBS = *VCDOBS^{MRG}
No obstruents in a margin must be voiced.

The full constraint ranking active in English loanword phonology in Korean is illustrated in (23):

(23) The constraint rankings for English loanword phonology in Korean

1st stratum	*VCLESSLENIS / [+son] ___ [+son], *VCDOBS^{MRG} MAX[+positive VOT], MAX[+long VOT], [MAX[-positive VOT] & MAX[-long VOT]]$_{segment}$, MAX[rel], DEP[rel]
2nd	MAX[-positive VOT]
3rd	*FORTIS
4th	MAX[-long VOT]
5th	*ASP, *VCDOBS

Now, let us analyze patterns that have been discussed in section 2. First, let us analyze the example in (1a i), in which English aspirated onset obstruents are realized as identical to those in Korean.

(24) voiceless aspirated onset stop → voiceless aspirated onset stop

/k^{h}i/ 'key'	*VCD OBS^{MRG}	MAX [+positive VOT]	MAX [+long VOT]	*FORTIS	*ASP	*VCD OBS
☞ a. k^{h}i					*	
b. k'i			*!	*		
c. ki			*!			
d. gi	*!	*	*			*

Three candidates (24b-d) are eliminated by a dominant MAX[+long VOT] since none of them preserves [+long VOT] in the input. (24d) is the worst candidate: it also violates another dominant *VCDOBS^{MRG} and MAX[+positive VOT] since a voiced stop is in a word-initial position and [+positive VOT] in the input has its output correspondent, [-positive VOT]. Thus, (24a) with an aspirated stop violating the lowest-ranked *ASP once, can be considered optimal. (24) reflects the tendency to preserve acoustically prominent elements such as aspirated stops.

Secondly, let us evaluate the analysis of the realization of English voiced obstruents in a word-initial position, shown in (1b i):

(25) word-initial VOICED stop → VOICELESS UNASPIRATED stop

/gæp'/ 'gap'	*VCD OBS^{MRG}	[MAX[-positive VOT]& MAX[-long VOT]]$_{segment}$	MAX [-positive VOT]	*FORTIS	MAX [-long VOT]	*ASP	*VCD OBS
a. **k**^{h}ɛp'		*!	*		*	*	
b. **k'**ɛp'			*	*!			
☞ c. **k**ɛp'			*				
d. **g**ɛp'	*!						*

(25d) beginning with a voiced stop is eliminated by the highest *VCDOBS^{MRG}. (25a) is ruled out by another highest [MAX[-positive VOT] & MAX[-long VOT]]$_{segment}$ since it does not preserve [-positive/-long VOT] in the input. Both remaining candidates (25b) and (25c), which do not preserve [-positive VOT] in the input, violate MAX[-positive VOT] so the next-lower-ranked *FORTIS plays a decisive role in selecting a winner. Thus, the former violating *FORTIS is ruled out, while the latter satisfying it becomes optimal.

Since the constraint disallowing a drastic change between input and output, [MAX[-positive VOT] & MAX[-long VOT]]$_{segment}$, and that prohibiting word-initial voiced stops, VCDOBS^{MRG}, are top-ranked, English word-initial voiced stops can become voiceless lenis ones in Korean. As a result, the interaction of constraints forces the contrast of voicing in English (**k**ey vs. **g**ap) to result in aspiration in Korean ([**k**^{h}]ey vs. [**k**]ap).

Thirdly, let us consider a case in which English unaspirated stops become aspirated in Korean, shown in (1a ii):

(26) voiceless UNASPIRATED stop → voiceless ASPIRATED stop

/strɛs/ 'stress'	*VCLESSLENIS /[+son]__[+son]	MAX [+positive VOT]	MAX [-positive VOT]	*FORTIS	MAX [-long VOT]	*ASP	*VCD OBS
☞ a. sit^{h}ɪrɛsi					*	*	
b. sit'ɪrɛsi				*!			
c. sitɪrɛsi	*!						
d. sidɪrɛsi		*!					*

(26c) is ruled out by a dominant *VCLESSLENIS / [+son] ___ [+son] since

it contains a voiceless lenis stop between vowels. (26d) is also ruled out by another dominant MAX[+positive VOT], since it does not preserve [+positive VOT] in the input. (26b) with a fortis stop, is eliminated by a relatively higher-ranked *FORTIS. (26a), which does not preserve [-long VOT] in the input, violates lower-ranked MAX[-long VOT] and *ASP than *FORTIS. Thus, it can be viewed as optimal.

Consequently, the correspondence between English unaspirated and Korean aspirated stops is the result of the constraint hierarchy, rather than an effect of the spelling system of English, as H. Kang (1996) argues. Since *FORTIS is ranked below *VCLESSLENIS / [+son] ____ [+son] and MAX[+positive VOT], which in turn is ranked above MAX[-long VOT], the voiceless unaspirated stops of English can surface as aspirated ones in Korean.

Fourthly, recall that English word-final stops, which may be optionally released or unreleased, are realized in Korean in three different ways, as shown in (1aiii): first, uniformly released as in [ɾop^{h}i] for English 'rope'; second, uniformly unreleased as in [pU**k˺**] for English 'book'; and finally, both released and unreleased as in [k^{h}ə**t**^{h}i] and [k^{h}ə**t˺**] for English 'cut'. Since all English word-final stops may be optionally released or unreleased and there is no plausible motivation for choosing one of the three realization patterns, we simply assume that the different realization patterns are the result of employing different types of acoustic outputs, as opposed to attempting to explain the choice. In other words, if Korean speakers employ the released output form of an English word-final stop as an input, its corresponding output in Korean will be released. This phenomenon can be illustrated by the following tableau for the analysis of [ɾop^{h}i] 'rope':

(27) voiceless CODA stop → ASPIRATED ONSET stop[4]

/rop˺/ 'rope'	*VCLESSLENIS /[+son]_[+son]	MAX [rel]	DEP [rel]	MAX [+positive VOT]	*FORTIS	MAX [-long VOT]	*ASP	*VCD OBS
☞ a. rop^{h}i						*	*	
b. rop'i					*!			
c. ropi	*!							
d. robi				*!				*
e. rop˺		*!						

[4] A phonetic symbol in the input, [˺], means released.

(27c) with a voiceless lenis stop occurring between vowels, is eliminated by the highest *VCLESSLENIS / [+son] ___ [+son]. (27e) is ruled out by a dominant MAX[rel], since a released /p˽/ in the input has an unreleased output correspondent, [p']. (27d) violates another dominant MAX[+positive VOT] since [+positive VOT] in the input becomes [-positive VOT] in the output. Thus, it cannot be optimal. (27b), violating relatively higher-ranked *FORTIS, cannot be optimal either. Thus, (27a) involving [+long VOT] in the output, can be a winner since it violates lower-ranked MAX[-long VOT] and *ASP. Note that even though (27a-d) have an epenthetic vowel, they do not violate DEP[rel], as the word-final stop of the input is released. Candidate (27e) with an unreleased stop, does not violate DEP[rel] either.

If Korean speakers happen to employ the unreleased output form of an English word-final stop as an input, its corresponding loanword form will be unreleased. This process can be illustrated by the following tableau for the analysis of [pUk'] 'book'.

(28) voiceless coda stop → UNRELEASED coda stop

/bUk'/ 'book'	*VCLESSLENIS /[+son]_[+son]	MAX [rel]	DEP [rel]	MAX [+positive VOT]	*FORTIS	MAX [-long VOT]	*ASP	*VCD OBS
a. pUkʰi			*!			*	*	
b. pUk'i			*!		*			
c. pUki	*!		*					
d. pUgi			*!	*				*
☞ e. pUk'								

Candidates (28a-d) are eliminated by a dominant DEP[rel] since the stops in the output are obligatorily released into the epenthetic vowels. Candidate (28e) satisfying all of constraints can be optimal.

Finally, if Korean speakers are exposed to both released and unreleased forms of an English word-final stop, then both forms can be the inputs, and both released and unreleased output forms will be produced, as illustrated in the following two tableaux involving [kʰətʰi] and [kʰət'] 'cut'. Since the evaluations for each candidate of 'cut' in (29) and (30) are equivalent to those in (27) and (28) respectively, only the tableaux are provided. (29) charts the case in which the released output of English is chosen as the input. Note that the underlined segments in (29-32) are considered in the constraint evaluation:

(29) voiceless CODA stop → ASPIRATED ONSET

/kʰət̚/ 'cut'	*VCLESSLENIS /[+son]_[+son]	MAX [rel]	DEP [rel]	MAX [+positive VOT]	*FORTIS	MAX [-long VOT]	*ASP	*VCD OBS
☞ a. kʰətʰi						*	*	
b. kʰətʼi					*!			
c. kʰəti	*!							
d. kʰədi				*!				*
e. kʰət̚		*!						

(30) charts the case in which an English output form with an unreleased stop, is employed as the input:

(30) voiceless CODA stop → UNRELEASED coda stop

/kʰət̚/ 'cut'	*VCLESSLENIS /[+son]_[+son]	MAX [rel]	DEP [rel]	MAX [+positive VOT]	*FORTIS	MAX [-long VOT]	*ASP	*VCD OBS
a. kʰətʰi			*!			*	*	
b. kʰətʼi			*!		*			
c. kʰəti	*!		*					
d. kʰədi			*!	*				*
☞ e. kʰət̚								

The different inputs are employed in the above two tableaux, and the choice in the input between released and unreleased forms determines the releasing status of the output forms.

Lastly, let us consider the case in which English word-final voiced stops become voiceless unreleased or voiced ones, as shown in (1b ii). The realization patterns of word-final voiced stops also depend on the choice of different kinds of acoustic outputs of English. If Korean speakers happen to employ the unreleased output form of an English word-final voiced stop as an input, its corresponding output in Korean will be unreleased—its original voicing is not maintained. This phenomenon is illustrated in the following tableau for the analysis of [kʰɨlləp̚] 'club':

(31) VOICED coda stop → VOICELESS UNRELEASED coda stop

/kʰlʌb̚/ 'club'	*VCD OBS^{MRG}	*VCLESSLENIS /[+son]_[+son]	MAX [rel]	DEP [rel]	MAX [-positive VOT]	*FORTIS	MAX [-long VOT]	*ASP	*VCD OBS
a. kʰillə**p**ʰi				*!	*		*	*	
b. kʰillə**p**'i				*!	*	*			
c. kʰillə**p**i		*!		*	*				
d. kʰillə**b**i				*!					*
e. kʰillə**b**'	*!								*
☞ f. kʰillə**p**'					*				

Candidates (31a-d) are eliminated by a dominant DEP[rel] since an unreleased /g'/ in the input, is released in the output. (31e) ending with a voiced stop, is ruled out by another dominant *VCDOBS^{MRG}. (31f), which does not preserve [-positive VOT] in the input, only violates relatively lower-ranked MAX[-positive VOT], so that it can be optimal.

If Korean speakers choose the released output form of English, its corresponding loanword form will be released. This can be illustrated by the following tableau for the analysis of [pɛ**d**i] 'bed':

(32) voiced CODA stop → voiced ONSET stop

/bɛd̚/ 'bed'	*VCD OBS^{MRG}	*VCLESSLENIS /[+son]_[+son]	MAX [rel]	DEP [rel]	MAX [-positive VOT]	*FORTIS	MAX [-long VOT]	*ASP	*VCD OBS
a. pɛ**t**ʰi					*!		*	*	
b. pɛ**t**'i					*!	*			
c. pɛ**t**i		*!			*				
☞ d. pɛ**d**i									*
e. pɛ**d**'	*!		*						*
f. pɛ**t**'			*!		*				

Candidates (32c) and (32e) are eliminated by top-ranked *VCLESSLENIS / [+son] ___ [+son] and *VCDOBS^{MRG}, respectively. The latter also violates another top-ranked MAX[rel] since a released /d˪/ in the input is unreleased in the output. (32f), with a voiceless unreleased [t'], is ruled out by MAX[rel]. Both (32a) and (32b), including [+positive VOT] in the output, violate a higher-ranked MAX[-positive VOT]. Thus, they cannot be considered optimal. (32d) violates the lowest-ranked *VCDOBS once, so that it can be selected as a winner.

Let us now discuss crucial differences between the present and previous approaches. The processes of deriving outputs in the both approaches can be compared in (33).

(33) A comparison between previous approaches and the present approach

a. PREVIOUS approaches		b. PRESENT approach	
(i) Input	/spaɪ/	(i) Input	/spaɪ/
(ii) **The Perceptual Level**	⬇ /sp^{h}aɪ/	(ii) Constraint Interaction	⬇
(iii) The Operative Level (Constraint Interaction)	⬇ [sip^{h}aɪ]	(iii) Output	[sip^{h}aɪ]

Previous approaches (H. Kang 1996, O. Kang 1996) do not provide a clear explanation for featural changes made in the Perceptual Level. More specifically, it is simply stated that the Korean phoneme inventory automatically constrains the realization of laryngeal features of English obstruents at the Perceptual Level, e.g. English voiceless unaspirated /p/ (33a i) is matched with voiceless aspirated [p^{h}] in Korean at the Perceptual Level (33a ii). Only the vowel insertion is determined in the Operative Level (33a iii) in which an Optimality Theoretic grammar is effective. These approaches are not appropriate from the perspective of OT, as discussed in section 3.3: first, the phoneme inventory is present in separation from the interaction of constraints; second, an intermediate level, i.e. perceptual level, is posited.

The present study is not subject to any of these problems: no intermediate stage is posited, as shown in (33b). In addition, we have provided detailed accounts for the correspondence between the phonetic output of English and its corresponding loanword form in Korean. We have specifically formalized the faithfulness constraints capturing similarities in the release prominence of English and Korean stops and those avoiding a drastic change between the phonetic output of English and its corresponding loanword form in Korean, e.g. MAX[+long VOT], [MAX[-positive VOT] & MAX[-long VOT]]$_{segment}$.

5. Conclusion

We have proposed a perception-based analysis of English loanwords in Korean, explaining the roles of the perceptual or acoustic factors. This

study can be distinguished from the previous researches by two aspects:

First, the realization of laryngeal features of English obstruents in Korean is captured by the interaction of constraints.

Second, there are no intermediate levels between the input and its output in our analyses of English loanwords.

References

Borden, Gloria, Katherine Harris, and Lawrence Raphael (1994) *Speech Science Primer: Physiology, Acoustics, and Perception of Speech*, 3rd ed., Baltimore, Williams & Wilkins.

Byrd, Dani (1993) '54,000 American Stops,' *UCLA Working Papers in Phonetics* 83, 97-115.

Cho, Taehong and Peter Ladefoged (1999) 'Variation and Universals in VOT: Evidence form 18 Languages,' *Journal of Phonetics* 27: 207-229. [http://www.ideallibrary.com]

Flemming, Edward (1995) *Auditory Representations in Phonology*, PhD dissertation, UCLA, Los Angeles, California.

Hayes, Bruce (1996) 'Phonetically Driven Phonology: The Role of Optimality Theory and Inductive Grounding,' Ms., UCLA, Los Angeles, California. [ROA-158, http://ruccs.rutgers.edu/roa.html]

_____ (1999) 'Phonological Acquisition in Optimality Theory: The Early Stages,' Ms., UCLA, Los Angeles, California. [ROA-327, http://ruccs.rutgers.edu/roa.html]

Itô, Junko and Armin Mester (1998) 'Markedness and Word Structure: OCP Effects in Japanese,' Ms., University of California, Santa Cruz. [ROA-255, http://ruccs.rutgers.edu/roa.html]

Jun, Jongho (1995) *Perceptual and Articulatory Factors in Place Assimilation: An Optimality Theoretic Approach*, PhD dissertation, UCLA, Los Angeles, California.

Kager, René (1999) *Optimality Theory*, Cambridge: Cambridge University Press.

Kang, Hyunsook (1996) 'English Loanwords in Korean,' *Studies in Phonetics, Phonology and Morphology* 2, 21-47.

Kang, Ong-mi (1996) 'An Optimality-Theoretic Analysis of Korean Loanword Phonology,' *Journal of Korean Linguistics* 28, 113-158. [http://www.chosun.ac.kr/~ongmi/biography/publication.htm]

Kim-Renaud, Young-Key (1974) *Korean Consonantal Phonology*, Seoul, Hanshin Publishing Co.

Ladefoged, Peter (1993) *A Course in Phonetics*, 3rd ed., Fort Worth, Harcourt Brace Jovanovich.

Ladefoged, Peter and Ian Maddieson (1996) *The Sounds of the World's Languages*, Oxford, Blackwell.

Lee, Ponghyung (1995) 'Korean Loanword Phonology: An Optimality Perspective,' *Korean Journal of Linguistics* 20-2, 121-151.

McCarthy, John and Alan Prince (1993) 'Prosodic Morphology I : Constraint Interaction and Satisfaction,' Ms., University of Massachusetts, Amherst and Rutgers University.

_____ (1995) 'Faithfulness and Reduplicative Identity,' in Jill Beckman, Laura Walsh, and Suzanne Urbanczyk, eds., *Papers in Optimality Theory, University of Massachusetts Occasional Papers* 18, Dept. of Linguistics, University of Massachusetts, Amherst, 249-384.

Ohala, John J. (1983) 'The Origin of Sound Patterns in Vocal Tract Constraints,' in MacNeilage, Peter F. ed., *The Production of Speech*, New York, Springer, 189-216.

Prince, Alan and Paul Smolensky (1993) 'Optimality Theory: Constraint Interaction in Generative Grammar,' Ms., Rutgers University, New Brunswick, and University of Colorado, Boulder.

Silverman, Daniel (1992) 'Multiple Scansions in Loanword Phonology, Evidence from Cantonese,' *Phonology* 9, 289-328.

Smolensky, Paul (1993) 'Harmony, Markedness, and Phonological Activity,' Handout to talk presented at Rutgers Optimality Workshop 1, 23 October 1993, New Brunswick, N.J. [ROA-87, http://ruccs.rutgers.edu/roa.html]

Stevens, Kenneth N. (1989) 'On the Quantal Nature of Speech,' *Journal of Phonetics* 17, 3-45.

Trask, Larry (1996) *A Dictionary of Phonetics and Phonology*, London and New York, Routledge.

Yang, Byunggon (1993) 'A Voice Onset Time Comparison of English and Korean Stop Consonants,' *Dongeui Nonjip* 20, 41-59.

ABSTRACT

English Loanword Phonology in Korean

Hyoeun Lee

The purpose of this paper is to provide a formal account for the realization of English loanwords in Korean. Our main concerns are the realization of laryngeal features of English obstruents in Korean, which can be summarized as follows. First, English aspirated onset obstruents are realized identically in Korean, e.g. /**kʰ**i/ → [**kʰ**i] 'key'. Second, voiceless unaspirated stops after /s/ in English are also realized as aspirated in Korean, e.g. /s**t**rɛs/ → [si**tʰ**ɨrɛsi] 'stress'. Third, English word-final unreleased stops become aspirated or unreleased ones in Korean, e.g. /ro**p**/ → [ro**pʰ**i] 'rope', /bU**k**/ → [pU**k˺**] 'book'. Fourth, English voiced obstruents in a word-initial position are consistently realized as voiceless unaspirated ones, e.g. /**g**æp/ → [**k**ɛp˺] 'gap'. Finally, English voiced obstruents in a word-final position become either voiceless or voiced ones in Korean, e.g. /kʰlʌ**b**/ → [kʰillə**p˺**] 'club', /bɛ**d**/ → [pɛ**di**] 'bed'.

Most previous researches on Korean loanword phonology (H. Kang 1996, O. Kang 1996) simply state that the Korean phoneme inventory automatically constrains these featural changes at the Perceptual Level, e.g. English voiceless unaspirated /p/ is matched with voiceless aspirated [pʰ] in Korean at the Perceptual Level. Only the vowel insertion is determined in the Operative Level in which an Optimality Theoretic grammar is effective. Thus, an intermediate level, i.e. Perceptual Level, is posited.

The present study proposes a perception-based analysis of English loanwords in Korean within the framework of Optimality-Theory. The realization of laryngeal features of English obstruents in Korean is captured by the interaction of the markedness constraints prohibiting elements which require articulatory effort and faithfulness constraints requiring to preserve the input forms. Specifically, faithfulness constraints such as MAX[+long VOT] play a crucial role in capturing similarities in release prominence of English and Korean stops and minimizing the differences between the phonetic output of English and its corresponding loanword form in Korean. We have shown that there are no intermediate levels between the input and

its output in our analyses of English loanwords.

Department of English Language and Literature
Yeungnam University
Dae-dong 214-1, Gyeongsan-si
Gyeongbuk 712-749, Korea
E-mail : chic7979@yahoo.co.kr